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ABSTRACT
        Cognitive psychology, which investigates how people
learn and how people know, can aid writers, who want readers to read
their material easily, understand the material, or comprehend the
material--three levels of processing complexity. Because readers vary
from being very knowledgeable in the subject of a document to lacking
in knowledge, and because they process information at different rates
and levels of efficiency, writers must "customize" their writing to
fit the reader's need for information and their abilities to process
that information. Cognitive psychology describes the information
processing of the mind so that a writer can construct text to take
advantage of this processing. Some examples of information processing
structures include syntactical structures (such as information
"chunking"), semantic structures (or the word's
denotative/connotative meaning), and contextual structures (what
setting, situation, and prior text provide). When writing
instructions, the writer must keep in mind these processes, along
with other reader assumptions and schema. For example, knowing that
the reader is concerned with many schema tells the writer to keep
things simple, reducing conditionals to manageable lengths and forms.
(A list of suggested readings is appended.) (MM)

COGNITIVE PSYCHOLOGY AND INSTRUCTIONS: NEW SCHEMES FOR OLD WAYS

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INTRODUCTION

No one need point out how far technical writing has come in recent years in understanding how to communicate information more effectively--that is, moving information from one who has it to one who needs it. Certainly, no small part in increasing that efficiency comes from applying research from such fields as composition and the composing process, linguistics, and the visual arts. We can now include cognitive psychology.

Cognitive psychologists investigate how we know, how we learn. Certainly, when the technical writer (and here I include both the person who writes for a living, a professional technical writer, and someone who is an occasional writer, an engineer or scientist who must report on activities) approaches a writing project, he or she must understand who the reader is, what the reader needs to know, what the reader needs to understand the material, and what the reader is to do with the material. Technical writers learn that readers vary from knowledgeable in the subject of the document to lacking in knowledge (the second point). Now, they can know that different readers process information at different rates and levels opf efficiency--a conclusion from many cognitive psychologists' research (the third point). With these two pieces of information about readers,

writers can "customize" the piece to fit the reader's need for information and abilities to process that information.

What writers want is for the reader to read the material easily, or understand the material, or comprehend the material (three levels of processing complexity), and can then help the reader accomplish that purpose. And here, again, psychology can help. With that in mind, I now want to look at models for communication (briefly) and information processing, then instructions as a sub-genre of technical writing, and conclude with some generalizations.

MODELS

Texts and journals are full of various "models" of how the human mind processes information. Most agree that somewhere in that processing, the reader will impose patterns on the material. For example, readers of English sentences are prepared culturally for a standard Subject-Verb-Object/Complement structure, recognizing that "John hit the ball" differs considerably from "The ball hit John." Knowing this, writers base their technical prose on S-V-O/C sentences. The basis for such syntactical decisions also rests on what cognitive psychologists tell us about chunking of information (we chunk when we remember phone numbers [2 groups of numbers], social security numbers [3 groups], the alphabet [4 groups], and other strings of discrete information on which we impose a pattern). This procedure is but one of three ways the mind extracts meaning. The other ways are semantic (the word's denotative/connotative meaning) and contextual (what setting, situation, and prior text give).

We also learn from the psychologists that the mind imposes
structures other than syntactical, semantic, and contextual. We
learn that the reader comes to the material for specific
information: should we buy computers for our department, for
example. In this case, the reader looks for information relative
to the kind of decision he or she has to make. Such information
could be total cost or any part of cost, flexibility of the
proposed system, need for additional personnel, and so on. They
will look for that information and ignore the rest. Such a
procedure is one type of <u>schema</u> (the recognition of
grammatical/syntactical patterns is another). The writer, we
learn, would do very well to pay attention to the reader's
processing abilities and information needs.

But what does this suggest, specifically, for that special
kind of writing called instructions? To understand that we need
to look first at a simplified model of communication, then how the
mind processes information, and finally how writers can use the
principles cognitive psychology suggests to prepare better
instructions.

Communication Model

Any communication situation contains four factors: a sender
of a message, the message, the means of sending the message, and
the receiver of the message. Within each of the four are a myriad
of subprocesses. For example, the writer has an idea to
communicate. That idea is a reality to the writer and the writer
must translate that idea into symbols (or, as some argue, the idea
forms by using symbols), translate the symbols into a

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transmittable form, and send it through the channel to the receiver. The receiver must receive the transmittable forms, decode them into symbols, and extract the idea from the symbols, thus recreating, we hope, the reality that the writer had in mind originally. So, the simple communication model is far from simple.

Information Processing Model

Cognitive psychologists have examined in almost minute detail what happens when the reader processes information. For example, a commonly accepted model--although not totally accepted--has the transmittable form (I'll call it a signal) received by a sensing device (say, the eye), where it is initially scanned for certain physical characteristics (legibility, brightness, line, etc.) Then, it moves through some kind of filtering process that operates at a physical level: for example, the eye can process fewer bits of material entering it than actually enter it and the mind can only deal with a tiny fraction of what the eye sends to it.

When the filters have finished, the pattern recognition process begins the extraction of meaning from the signals. Here, we find the subtle, subconscious processing of words in linear fashion arranged in chunks that the mind can anticipate, extracting the syntactic level of meaning. Simultaneously, the mind is working on the semantic meaning of the signal, using long-term memory to bring in what individual words mean.

Then, too, at the conscious level are the schema I mentioned. If the particular signal does not produce meaning that fits with

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the schema, it passes on through. If it does qualify under a schema, it moves into short-term memory for more processing. At these stages, the third level of meaning (contextual) plays a part because the mind must dedicate some memory capacity to extracting meaning (antecedent for a pronoun, for example). Additional, external contextual material is brought in for more processing and extraction of meaning. If all is in order (that is if it fits the two levels of schema), the mind reacts or responds. If more processing is necessary, we get the equivalent of "well, is this really worth the effort?" And the mind drifts away or moves the reading process from a subconscious level to a conscious level where the reader has to "think" and figure out what the writer meant.

So the simplified model of communication and generalized model of information processing are far from simple. Yet, they both offer the writer important insights that translate into strategies that can help the reader read, understand, or comprehend the material.

INSTRUCTIONS

So far, I have been generalizing about prose. Now, I need to turn to the particular type of prose this panel is charged with discussing: Instructions.

Instructions are odd forms of communication because they begin with violations of many assumptions. The mind is prepared for a S-V-O/C sentence pattern (or some variation that helps to contribute to meaning such as subordination, coordination and so forth). When it encounters an instruction, it must infer the

subject. Likewise, it cannot discard as a lower level of meaning
any opening. (Here I follow the suggestion of Joseph Williams and
others: the opening of a sentence is a place where the writer can
place old information, something the reader can be assumed to be
relatively familiar with). In place of a comfortable "The" or
"A," the reader encounters either a command form of the verb
("Press") or a conditional "If . . .").

Granted that when the reader turns to a instruction, it is
with a much different schema than when turning to, say a
feasibility report on buying computers. Readers come to
instructions usually unwillingly ("When in doubt, read the
instructions"), and with considerable fear and trepidation. Many
a computer company and software house has gone broke because they
did not recognize this one fundamental.

Having encountered the unusual opening, the reader also moves
the reading process from the subconscious to the conscious levels
("I must understand how to move this block of text or else. . .
." The dire torture is left to an already vivid imagination--
black data smoke curling laughingly from the top of the monitor is
but one). Given a condition, and especially a long condition, and
visions of the 1040 rush to mind ("If the income from line 39 is .
. . ") The reader must now proceed to untangle the skein of
tangled "if's" and "then's" to get done some job. An already
overloaded processing system is even more taxed (oops) by having
to keep a conditional in mind. And then the writer goes and does
a cute trick like string conditionals together when a simplified
breakdown into more easily managed steps would make it less

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imposing, employing large amounts of what computer people call "overhead"--the mind is trying to extract meaning at the cost of overall concepts, for example.

Another element in the nightmare comes from the writer assuming that the reader knows how to perform each step. Consider this: The reader is replacing a voltage regulator in a car that has the alternator and regulator in one package. Off comes the alternator cover (fairly simple), write down the part number (also easy), order the new part (piece of cake), install the new part (WOW!). Our reader finds that, yes, the new part has the same number of wires that the old one had, but the instructions suggest (nay, command in that wonderfully omniscient imperative voice) "Connect as shown." The reader now faces a myriad of inferences, trying to dredge from memory some basic laws of logic that will announce that, yes, the instruction writer does know what he or she is talking about, and yes, you should connect as shown. Then comes step two's warning: Always use a heat sink when re-soldering the connections. The reader knows what "heat" means and knows what a "sink" is, but what is a heat sink? Do the work in the kitchen? Inferences fail because the writer had made a mistake--failing to appreciate that someone other than a certified mechanic would replace a voltage regulator.

You may quibble about my example, but my point remains valid. Writers must understand how the reader processes the information and accommodate it. (Our reader is, unknowingly, extremely lucky because the writer did assume that an American would read the instructions. Had the part been one not meant for export [made in

England and shipped to this country], the reader would have found
"thermal shunt" in place of "heat sink."   Then what?)

Before we roundly condemn our writer, let me hasten to add
that a quick turn to a shop manual shows the operation in
question, and the harried reader learns that a "heat sink" or
"thermal shunt" is a metal tool (needlenose pliers, for example,
that absorbs the extra heat generated when a soldering iron heats
a terminal. The sink causes the heat to bypass delicate parts. A
visual clearly shows this. We must also defend the writer because
it is unusual for a true novice to try to replace a voltage
regulator inside an alternator (in American cars with such
devices, they are black boxes that bolt to the inside of a fender
in the engine compartment and offer no such problems other than
getting the wires re-attached in the correct order).

CONCLUSION

So, what do we have? Cognitive psychology opens the
information processing of the mind so that the writer can
construct text that takes advantage of it. In instructions,
knowing that the reader is concerned with many schema tells the
writer to keep things very simple--not in the "See Dick run" way
of simple, but in the keep to one-step-per-instruction way, reduce
conditionals to manageable lengths and forms, and realize that the
reading process occurs at a more conscious level in instructions
than the reading process for a feasibility report.

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